ANCHORING SYSTEM FOR INJECTION MOLDED MAGNETS ON A FLUX RING OR MOTOR HOUSING

Cross-Reference to Related Application

This patent application is a continuation-in-part application of United States Application Serial No. 09/492,059 filed January 27, 2000 entitled **ANCHORING SYSTEM FOR INJECTION MOLDED MAGNETS ON A FLUX RING OR MOTOR HOUSING**, the specification and drawings of which are herein expressly incorporated by reference.

Background and Summary of the Invention

The present invention relates to power tools and, more particularly, to motors for power tool flux rings with anchors to retain molded magnets on the flux ring.

In motor construction, the motor magnets must be retained on the housing or separate flux ring within the housing. Ordinarily, these magnets have been glued or adhered to the metallic ring or housing. In adhering the magnets to the metallic surface so that the magnets do not shift during use, various types of adhesives have been used. While some of the adhesives have been satisfactory, some adhesives work better than others. As the adhesives age, it is possible that if the power tool is dropped, that the sudden shock will destroy the bond between the magnet and the housing or ring, enabling the magnet to travel within the motor. When this occurs, the motor ceases to function. Thus, it would be desirable to provide a mechanism to retain the magnets in position on the ring or housing.

The present invention provides the art with a mechanism to retain magnets onto a flux ring or motor housing. Due to the advent of molded magnets, it is possible to provide an anchor in the flux ring or housing to retain the molded material on the ring or housing. One such anchoring member is an aperture having a counter-sink on

the exterior of the ring or housing. Thus, when the magnet is molded onto the ring, the magnetic material that passes through the ring into the counter-sink forms a solid rivet-shaped fastener. Also, anchors may be stamped out of the ring or housing and project into the interior of the ring to receive the molded magnetic material. The anchors include gussets to reinforce the bend points to enhance the strength of the anchors and help resist deformation during molding. Due to the anchors being unitarily formed or stamped from the ring or housing, an aperture is left in the ring or housing after stamping, which is likewise filled with the molded magnetic material.

In accordance with a first aspect of the invention, a flux ring comprises an annular housing. At least one molded magnet is received on the housing. An anchor on the housing retains the at least one magnet on the annular housing. The anchor is unitarily formed with the housing. The anchor includes at least one bend. A reinforcement member is positioned at the bend to strengthen the anchor. The annular housing is metal with the anchor projecting radially from the housing. The projecting anchor has an aperture immediate the anchor on the housing. Thus, the magnetic material molds around the anchor and into the aperture. The anchor may have several different shapes. Preferably, the anchor has a rectangular shape, with one or both ends connected to the housing. Also, the anchor may have an L- or T-shape with one end connected to the housing.

In accordance with a second aspect of the invention, a motor comprises a stator assembly with the stator assembly including a flux ring. The flux ring comprises an annular housing. At least one molded magnet is received on the housing. An anchor on the housing retains the at least one magnet on the annular housing. The anchor is unitarily formed with the housing. The anchor includes at least one bend. A reinforcement member is positioned at the bend to strengthen the anchor. The annular housing is metal with the anchor projecting radially inward from the housing.

The projecting anchor has an aperture immediate the anchor on the housing. Thus, the magnet molds around the anchor and into the aperture. The anchor may have several different shapes. Preferably, the anchor has a rectangular shape, with one or both ends connected to the housing. Also, the anchor may have an L- or T-shape with one end connected to the housing. Also, the motor comprises an armature rotatable within the stator assembly. A commutator is rotatable with the armature and connected to the armature via a shaft. A brush assembly is associated with the commutator.

In accordance with a third aspect of the invention, a power tool comprises a housing with a motor in the housing. The motor comprises a stator assembly with the stator assembly including a flux ring. The flux ring comprises an annular housing. At least one molded magnet is received on the housing. An anchor on the housing retains the at least one magnet on the annular housing. The anchor is unitarily formed with the housing. The anchor includes at least one bend. A reinforcement member is positioned at the bend to strengthen the anchor. The annular housing is metal with the anchor projecting radially inward from the housing. The projecting anchor has an aperture immediate the anchor on the housing. Thus, the magnet molds around the anchor and into the aperture. The anchor may have several different shapes. Preferably, the anchor has a rectangular shape, with one or both ends connected to the housing. Also, the anchor may have an L- or T-shape with one end connected to the housing. Further, the anchor may have a truncated cone shape with an axial aperture through the cone. Also, the motor comprises an armature rotatable within the stator assembly. A commutator is rotatable with the armature and connected to the armature via a shaft. A brush assembly is associated with the commutator. Also, the power tool includes an output member coupled with the motor shaft. An actuator member is electrically coupled between the motor and the power source to energize

and de-energize the motor. In turn, when the motor is energized, the output member rotates.

Additional objects and advantages of the present invention will become apparent from the detailed description of the preferred embodiment, and the appended claims and accompanying drawings, or may be learned by practice of the invention.

Brief Description of the Drawings

Figure 1 illustrates a cross-section view of a power tool in accordance with the present invention.

Figure 2 illustrates a perspective view of a flux ring in accordance with the present invention.

Figure 3 is a cross-section view through Figure 2 along line 3-3 thereof.

Figure 4 is a perspective view of a flux ring like that illustrated in Figure 2 with the magnets removed.

Figures 5-8 illustrate perspective views of additional embodiments of flux rings in accordance with the present invention.

Detailed Description of the Preferred Embodiment

Turning to Figure 1, a power tool in accordance with the present invention is illustrated and designated with the reference numeral 10. The power tool 10 is illustrated as a drill; however, any type of power tool such as a screwdriver, sander, rotary tool, clippers, saw or the like which utilize an electric motor may be used with the motor of the present invention. The power tool 10 includes a housing 12 which surrounds a motor 14. An activation member 16 is coupled with the motor 14 as well as with a power source 18. The power source 18 may be a power cord (AC current)

or the power tool may have a battery (DC current) as shown. The motor 14 is coupled with an output 20 which may include a transmission 22 and a chuck 24 to retain a tool (not shown) with the drill.

The motor 14 includes a stator assembly 30 which includes a housing 32, flux ring 34, and magnets 36 and 38. An armature 40 includes a shaft 42, a rotor 44 with laminations 46 and windings 48, as well as a commutator 50 coupled with the shaft 42. The motor also includes end plates 52 and 54. End plate 52 includes a bearing 56 which balances one end of the shaft 58 which is coupled with a pinion 60 which is part of the power tool output. Brushes 62 and 64 which are associated with the commutator 50. A bearing 70 is also coupled with the end cap to balance rotation of the shaft 42.

Turning to Figure 2, the flux ring 34 is illustrated with magnets 36 and 38. The magnets 36 and 38 are of a molded magnetic material. Preferably, the molded material is an injection molded material. The ring 34 is positioned within a die and the magnetic material is molded onto the flux ring. Also, the housing 32 may be used as the flux ring. Thus, the discussion with respect to the ring 34 may equally apply to the metallic housing 32 of the motor 14.

The flux ring 34 includes anchors 80 to retain the magnets 36 and 38 onto the ring 34. The anchors 80 may be of two types. First, anchor 82 is an aperture formed in the housing 34. The aperture 82 has a first portion 84 and a second counter-sink portion 86. The counter-sink portion 86 extends to the exterior 88 of the ring 34. Thus, as seen in the cross-section in Figure 3, as the molded magnetic material is received in the aperture 82, the molded material has a neck 92 and a head 94. The head 94 and neck 92 provide an overall rivet appearance, thus the large head 94 acts to retain the magnet 36, 38 on the ring 34. The ring 34 may be comprised of just a plurality of aperture anchors 82 to retain the magnets on the ring 34.

Additional anchors 96 may be utilized on the ring. Anchors 96 project from the interior surface 98 of the ring 34. Ordinarily, the anchors 96 are stamped or the like into the ring 34 forming an aperture 100 immediately adjacent the projecting anchor 96. Thus, when the molded magnetic material forms around the projecting anchor 96, it likewise goes under the anchor 96 and fills in the aperture 100. This provides a firm securement for the magnet onto the ring 34.

The ring 34 illustrated in Figure 2 is illustrated in Figure 4 without the magnetic material. As can be seen, the projecting anchor 96 has an overall rectangular shape with ends 102 and 104 unitarily formed with the ring 34. The anchor has bends 106, 108 between the legs 110, 112 and web 114. A reinforcement gusset 116 is positioned at the bends 106, 108. The reinforcement gusset 116 strengthens the anchor during the molding process to maintain its shape. The reinforcement gusset 116 may be a dimple or indent at the bend. Likewise, the aperture anchors 82 are illustrated in Figure 4. Also, aperture anchors 82 could be removed and only radially projecting anchors 96 would be used to retain the magnets on the housing.

The rings 34 are ordinarily formed from a rectangular stamped sheet material. The rectangular shaped sheet metal is stamped to form the apertures 82 or the projecting anchors 96 including the reinforcement gussets 116, or both, depending upon which anchoring system is desired. The flat sheet metal part is then rolled into an annular ring and may have a butt joint 99 (as shown), meshing end 101 (as seen in Figure 6), or the like, forming the ring. The ring is then placed within a die where the magnetic material is injection molded onto the ring. The injection molded material moves through the apertures 82 and around the projecting anchors 96 as illustrated in Figure 3. Then the ring is removed from the die, it is ready for insertion into the motor housing. Likewise, the motor housing itself could be utilized as the ring. In this

case, the ring would not be present and the magnets would be molded directly onto the housing with the housing being formed as described.

Moving to Figures 5-8, additional embodiments of the present invention are illustrated. In Figure 5, the flux ring 34' includes optional aperture anchors 82 like those previously described. Here, the projecting anchors 120 have an overall rectangular shape with one end secured to the ring 34'. The reinforcement gusset 116 is formed at the bend. Also, aperture 122 is immediately adjacent the projecting anchor 120.

Moving specifically to Figure 6, another ring 34" is shown. Here, the ring 34" includes optional aperture anchors 82 like those previously described. Here, the projecting anchor 130 has an overall L-shape. The projecting L is secured at one end to the ring 34". The reinforcement gusset 116 is formed near the ring 34". The aperture 132 immediately adjacent the projecting L-shaped anchor 130 likewise has an L-shape.

Turning to Figure 7, an additional embodiment is shown. Here, the ring 34'" includes optional aperture anchors 82 like those previously defined, as well as projecting anchors 140. The projecting anchors 140 have an overall rectangular shape and are angled inward directly out of the ring 34'". The reinforcement gusset 116 is formed near the ring 34'". Also, the aperture 142 is immediately adjacent the projecting anchor 140.

Figure 8 illustrates an additional embodiment of the present invention. The flux ring 34"" includes optional aperture anchors 82 like those previously defined. The projecting anchors 160 have an overall T-shape. The apertures 162 immediately adjacent the T-shaped projecting member 160 likewise have a corresponding T-shape. The reinforcement gusset 116 is formed near the ring 34"". Thus, as the magnetic material is molded onto the ring, the T-shaped projection 160 is covered by

the magnetic material while the T-shaped aperture 162 receives magnetic material both holding the magnets in place on the ring 34"".

While the above detailed description describes the preferred embodiment of the present invention, the invention is susceptible to modification, variation, and alteration without deviating from the scope and fair meaning of the subjoined claims.